relaxed and extend themselves. Killing requires from three to ten hours depending on temperature. When they are dead, which can be tested by pinching the tentacles with a pair of forceps, if there is no reaction they are ready for fixing. For fixing add enough 40 percent formaldehyde to make a solution of one part of the formaldehyde to 16 parts of water and leave for from 24 to 48 hours. After fixing they should be removed to 70 percent alcohol for preservation.

When this method is used the slugs are preserved life size with the color patterns clear, and there is no fermentation of the stomach contents which sometimes happens with the old method. Although the killing is hastened by warmth, care should be taken to prevent overheating. The heat produced by parking a car in the sun will ruin the specimens if they are left inside.

SOME NOTES ON HALIOTIS

By JOSHUA L. BAILY, JR.

For some years past, I have been assembling data concerning the abalones of this coast with the idea of someday publishing a detailed monograph of this interesting group. But a recent contribution to the Natural History Museum of San Diego by Mr. Reg Richardson, an amateur diver of La Jolla, contains such interesting material that it appears justifiable to place it on record without further delay.

Among this was a single specimen of *Haliotis sorensoni* Bartsch. This is the species formerly called *H. assimilis* Dall in local collections, but it is not that species. *H. sorensoni* may readily be distinguished by its nearly circular outline and its relatively thin shell. Locally it is known as the "true pink abalone" to distinguish it from the "false pink abalone" which is *H. corrugata* Gray. So far as I am aware, *H. sorensoni* has never been recorded from La Jolla before, although it has undoubtedly been taken there, as it has been reported from Point Concepcion to the north and from Guadalupe to the south.

A more interesting find, however, consists of a pair of specimens of what I believe to be the lost species of C. B. Adams, *H.*

ponderosa. They fit perfectly the description and figure given by Bartsch.[1] They resemble large coarse specimens of *H. rufescens* Swainson and perhaps might more appropriately be considered a variety of that species, though well worthy of a distinguishing name. However, until the opportunity of comparing them with the type has been realized it is better to withhold final judgment. An authentic specimen of *H. rufescens* was taken with them, and Mr. Richardson pointed out that the meat in *H. rufescens* is light while in the supposed *H. ponderosa* it is dark. This difference may prove to have greater taxonomic significance than any of the purely conchological features.

Although there were no black abalones in Mr. Richardson's donation, perhaps a few observations on the nomenclatorial vicissitudes through which this species has passed may not be considered out of place at this time. Formerly two species of blacks were recognized, *H. cracherodii* Leach, in which the perforations are variable in size and irregularly placed, both with respect to their common locus as well as to each other, and *H. californiensis* Swainson in which the perforations are placed with geometrical precision. The latter has a significantly greater number of perforations, but the ranges of variation of the two overlap. Recently Bartsch [2] has united the two in a single species on the ground that specimens from San Bonita (*sic*, error for San Benito) Islands form perfect intergrades connecting the two. Personally I concur in this conclusion, but for a different reason.

Occasionally specimens of black abalone are found which are completely imperforate. Since the two recognized species differ only in the nature of the perforations it follows that imperforate specimens might be referred with equal propriety to either species. If two species are admitted two corresponding varieties would have to be recognized, each of which would be entitled to a name, although the two would be absolutely indistinguishable. Since there are no criteria of taxonomic value other than the perforations, this anomaly can be avoided only by uniting the two species or by giving separate specific rank to the imperforate form.

[1] Proc. U. S. N. M., v. 89, p. 52, pl. 7, 1940.
[2] Loc. cit., p. 55.

The first record of the imperforate form seems to have been made by Kelsey [3] who referred to it as a freak and gave it no name, though he subsequently told me that he considered it a legitimate variety. Mr. Kelsey obtained his single specimen from Mr. Frank X. Holzner, the game warden of San Diego County, who kept a curio store on the site of the present Crystal Palace Building in San Diego, who in turn found it in a shipment of shells from Ensenada. I was in Mr. Holzner's store when he found the shell and gave it to Mr. Kelsey, and can certify to the accuracy of the latter's statement that it was devoid of holes and had no indication of any intention in that direction.

Later Hemphill [4] described an imperforate variety which he called *H. cracherodii holzneri.* Although he declared that Kelsey's specimen belonged to this variety inspection of Hemphill's three cotypes now in the collection of the San Diego Society of Natural History reveals conclusively that this was not the case. Hemphill's specimens are all pathological monstrosities. The black abalone, unlike the other species, sometimes lives on cobble stones, and, in conforming to the surface of the cobbles the shell becomes distorted, so that the aperture is curved in three dimensions. If the cobbles are rolled about as the result of wave action during a storm, the abalones adhering to them will be exposed to the risk of fracture, and since the locus of the perforations is structurally the weakest part of the shell it is here that the fracture is most likely to occur. If then the mollusk succeeds in salvaging the fragments of its covering by cementing them together with a fresh deposit of calcareous matter the perforations may become obliterated. This is quite obviously what happened with Hemphill's types. There is a well pronounced scar where the holes used to be, and consequently his name lacks taxonomic significance.

Later, Dall [5] described the normally imperforate form as *H. cracherodii imperforata* and still later he figured it.[6] (Incidentally his figure is not the original specimen found by Mr.

[3] Nautilus, v. 18, p. 67, 1904.
[4] Trans. San Diego Soc. Nat. Hist., v. 1, no. 2, p. 4, 1907.
[5] Proc. U. S. N. M., v. 56, p. 370, 1919.
[6] Bull. U. S. N. M., 112, p. 184, pl.